PCT/AU02/00854

[redacted]

Patent Office
Canberra

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PR 6197 for a patent by METAL STORM LIMITED as filed on 06 July 2001.

WITNESS my hand this
Tenth day of July 2002

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
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PRIORITY DOCUMENT
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Annex A to 8645MET dated 9 April 2002

Australian Provisional Application PR6197
Metal Storm Limited
FIRE FIGHTING [redacted]

Search Statement

A method of fighting a fire having a relatively large volume, said method including the steps of:

(a) providing an ordnance having a plurality of barrel assemblies, said barrel assemblies each having a barrel, a plurality of projectiles containing a fire retardant axially disposed within the barrel for operative sealing engagement with the bore of the barrel, and discrete propellant charges for propelling respective projectiles sequentially through the muzzle of the barrel;

(b) identifying a target volume to be doused with fire retardant; and

(c) discharging a multiplicity of the projectiles having the fire retardant contained therein from the ordnance whereby said fire retardant is dispersed through the target volume.

Suitably, the discharging step includes the further step of activating bursting means in each projectile for opening a containment therein holding said fire retardant at different predetermined delays, whereby the fire retardant may be dispersed within said volume at a plurality of heights above ground level.

PIZZEYS

PR0177

AUSTRALIA
Patents Act 1990

P/00/003
Section 29
Revised 2/98

Patent Request : Provisional Application

We, being the person identified below as the Applicant, request the grant of a patent for an invention described in the accompanying provisional specification.

Full application details follow

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Invention Title:	FIRE FIGHTING
Name of actual inventor:	James Michael O'Dwyer
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DATED THIS SIXTH DAY OF JULY 2001

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IP Australia
Documents received on:
- 6 JUL 2001
Brisbane

Batch No

FEE: A$80.00

FIRE FIGHTING

The present invention relates to fire fighting. In particular the present invention relates to a method and apparatus for fire fighting.

We have now found a method of fire fighting that permits an expanse of fire to be, substantially simultaneously, doused with a fire retardant thereby making the fire easier to contain and ultimately to completely extinguish. Accordingly there is provided a method of fire fighting wherein said method includes identifying an target area to be doused with fire retardant and discharging a multiplicity of projectiles having the fire retardant contained therein from an ordinance having at least one barrel assembly, said at least one barrel assembly having a barrel, a plurality of projectiles axially disposed within the barrel for operative sealing engagement with the bore of the barrel, and discrete propellant charges for propelling respective projectiles sequentially through the muzzle of the barrel whereby said fire retardant is dispersed over the target area.

In another aspect there is provided a fire fighting apparatus including a targeting system for identifying a target area to be doused with fire retardant and an ordinance for discharging a multiplicity of projectiles having the fire retardant contained therein from said ordinance wherein said ordinance includes at least one barrel assembly, said at least one barrel assembly having a barrel, a plurality of projectiles axially disposed within the barrel for operative sealing engagement with the bore of the barrel, and discrete propellant charges for propelling respective projectiles sequentially through the muzzle of the barrel whereby said fire retardant is dispersed over the target area.

It has been found that by dousing "hot spots" in a fire the intensity of the fire may be reduced. Thus conventional fire fighting techniques may be made more effective. Advantageously infra-red targeting systems may be used in the present invention to assist in identifying and targeting "hot spots" or other selected locations within a fire. Alternatively visual identification of a target area may be utilised.

The target area may be selected as a "hot spot" as described above. Alternatively the target area may be selected to assist in protecting people or property from fire. For example, in order to assist fire fighters or victims trapped by fire to escape from danger, a target area in the form of a corridor or escape route may be identified.

The type of fire retardant that may be deployed in the method of the present invention includes a wide variety of fire retardants. Fire retardants are generally classified as types A. B or C and may be used on fires that burn on different fuel sources. The method of the present invention may deploy a powder retardant that is suitable on all classes of fire. Alternatively, a multiplicity of barrel assemblies may be used to selectively fire a variety of fire retardants that may be selected to suit the particular fire.

The ordinance includes a number of barrel assemblies including a barrel; a plurality of projectiles axially disposed within the barrel for operative sealing engagement with the bore of the barrel, and discrete propellant charges for propelling respective projectiles sequentially through the muzzle of the barrel discharge projectiles to douse the fire. Such barrel assemblies are described in International Patent Application Nos. PCT/AU94/00124, PCT/AU96/00459 and PCT/AU97/00713.

The projectile may be round, conventionally shaped or dart-like and the fins thereof may be offset to generate a stabilising spin as the dart is propelled from a barrel that may be a smooth-bored barrel.

The projectile charge may be form as a solid block to operatively space the projectiles in the barrel or the propellant charge may be encased in metal or other rigid case which may include an embedded primer having external contact means adapted for contacting an pre-positioned electrical contact associated with the barrel. For example the primer could be provided with a sprung contact which may be retracted to enable insertion of the cased charge into the barrel and to spring out into a barrel aperture upon alignment with that aperture for operative contact with its mating barrel contact. If desired the outer case may be consumable or may chemically assist the propellant burn. Furthermore an assembly of stacked and bonded or separate cased charges and projectiles may be provide for reloading a barrel.

Each projectile may include a projectile head and extension means for at least partly defining a propellant space. The extension means may include a spacer assembly that extends rearwardly from the projectile head and abuts an adjacent projectile assembly.

The spacer assembly may extend through the propellant space and the projectile head whereby compressive loads are transmitted directly through abutting

adjacent spacer assemblies. In such configurations, the spacer assembly may add support to the extension means which may be a thin cylindrical rear portion of the projectile head. Furthermore the extension means may form an operative sealing contact with the bore of the barrel to prevent burn leakage past the projectile head.

The spacer assembly may include a rigid collar which extends outwardly to engage a thin cylindrical rear portion of the malleable projectile head inoperative sealing contact with the bore of the barrel such that axially compressive loads are transmitted directly between spacer assemblies thereby avoiding deformation of the malleable projectile head.

Complementary wedging surfaces may be disposed on the spacer assembly and projectile head respectively whereby the projectile head is urged into engagement with the bore of the barrel in response to relative axial compression between the spacer means and the projectile head. In such arrangement the projectile head and spacer assembly may be loaded into the barrel and there after an axial displacement is caused to ensure good sealing between the projectile head and barrel. Suitably the extension means is urged into engagement with the bore of the barrel.

The projectile head may define a tapered aperture at its rearward end into which is received a complementary tapered spigot disposed on the leading end of the spacer assembly, wherein relative axial movement between the projectile head and the complementary tapered spigot causes a radially expanding force to be applied to the projectile head.

The barrel may be non-metallic and the bore of the barrel may include recesses that may fully or partly accommodate the ignition means. In this configuration the barrel houses electrical conductors which facilitate electrical communication between the control means and ignition means. This configuration may be utilised for disposable barrel assemblies that have a limited firing life and the ignition means and control wire or wires therefor can be integrally manufactured with the barrel.

A barrel assembly may alternatively include ignition apertures in the barrel and the ignition means are disposed outside the barrel and adjacent the apertures. A non-metallic outer barrel that may include recesses adapted to accommodate the ignition means may surround the barrel. The outer barrel may also house electrical

conductors that facilitate electrical communication between the control means and ignition means. The outer barrel may be formed as a laminated plastics barrel which may include a printed circuit laminate for the ignition means.

The barrel assembly may have adjacent projectiles that are separated from one another and maintained in spaced apart relationship by locating means separate from the projectiles, and each projectile may include an expandable sealing means for forming an operative seal with the bore of the barrel. The locating means may be the propellant charge between adjacent projectiles and the sealing means suitably includes a skirt portion on each projectile which expands outwardly when subject to an in-barrel load. The in-barrel load may be applied during installation of the projectiles or after loading such as by tamping to consolidate the column of projectiles and propellant charges or may result from the firing of an outer projectile and particularly the adjacent outer projectile.

The rear end of the projectile may include a skirt about an inwardly reducing recess such as a conical recess or a part-spherical recess or the like into which the propellant charge portion extends and about which rearward movement of the projectile will result in radial expansion of the projectile skirt. This rearward movement may occur by way of compression resulting from a rearward wedging movement of the projectile along the leading portion of the propellant charge it may occur as a result of metal flow from the relatively massive leading part of the projectile to its less massive skirt portion.

Alternatively the projectile may be provided with a rearwardly divergent peripheral sealing flange or collar which is deflected outwardly into sealing engagement with the bore upon rearward movement of the projectile. Furthermore the sealing may be effected by inserting the projectiles into a heated barrel which shrinks onto respective sealing portions of the projectiles. The projectile may comprise a relatively hard mandrel portion located by the propellant charge and which cooperates with a deformable annular portion may be moulded about the mandrel to form a unitary projectile which relies on metal flow between the nose of the projectile and its tail for outward expansion about the mandrel portion into sealing engagement with the bore of the barrel.

The projectile assembly may include a rearwardly expanding anvil surface supporting a sealing collar thereabout and adapted to be radially expanded into

sealing engagement with the barrel bore upon forward movement of the projectile through the barrel. In such a configuration it is preferred that the propellant charge have a cylindrical leading portion which abuts the flat end face of the projectile.

The projectiles may be adapted for seating and/or location within circumferential grooves or by annular ribs in the bore or in rifling grooves in the bore and may include a metal jacket encasing at least the outer end portion of the projectile. The projectile may be provided with contractible peripheral locating rings that extend outwardly into annular grooves in the barrel and that retract into the projectile upon firing to permit its free passage through the barrel.

The electrical ignition for sequentially igniting the propellant charges of a barrel assembly may preferably include the steps of igniting the leading propellant charge by sending an ignition signal through the stacked projectiles, and causing ignition of the leading propellant charge to arm the next propellant charge for actuation by the next ignition signal. Suitably all propellant charges inwardly from the end of a loaded barrel are disarmed by the insertion of respective insulating ruses disposed between normally closed electrical contacts.

Ignition of the propellant may be achieved electrically or ignition may utilise conventional firing pin type methods such as by using a centre-fire primer igniting the outermost projectile and controlled consequent ignition causing sequential ignition of the propellant charge of subsequent rounds. This may be achieved by controlled rearward leakage of combustion gases or controlled burning of fuse columns extending through the projectiles.

In another form the ignition is electronically controlled with respective propellant charges being associated with primers which are triggered by distinctive ignition signals. For example the primers in the stacked propellant charges may be sequenced for increasing pulse width ignition requirements whereby electronic controls may selectively send ignition pulses of increasing pulse widths to ignite the propellant charges sequentially in a selected time order. preferably however the propellant charges are ignited by a set pulse width signal and burning of the leading propellant charge arms the next propellant charge for actuation by the next emitted pulse.

Suitably in such embodiments all propellant charges inwardly from the end of a loaded barrel are disarmed by the insertion of respective insulating fuses disposed

between insertion of respective insulating fuses disposed between normally closed electrical contacts, the fuses being set to burn to enable the contacts to close upon transmission of a suitable triggering signal and each insulating fuse being open to a respective leading propellant charge for ignition thereby.

A number of projectiles can be fired simultaneously, or in quick succession, or in response to repetitive manual actuation of a trigger, for example. In such arrangements the electrical signal may be carried externally of the barrel or it may be carried through the superimposed projectiles which may clip on to one another to continue the electrical circuit through the barrel, or abut in electrical contact with one another. The projectiles may carry the control circuit or they may form a circuit with the barrel.

The fire fighting capabilities of the method and apparatus of the present invention may advantageously be applied to fighting fires in a relatively flat, two-dimensional plane. The projectiles containing fire retardant may be detonated to disperse the fire retardant in a simple plane. For example, the surface of the fuel source which feeds grass fires, and spilled fuel fires is generally a rather flat two dimensional plane which is often horizontal. These fires can be effectively engaged by the mortar box means of distributing impact activated 'grenades' that release fire retardant powder. Although grass and brush may have a vertical fuel depth of say two metres, such a depth can generally be expected to be doused with fire retardant by the normal distribution effect of impact bursting grenades.

It may be preferable to burst the grenades and disperse the fire retardant above the plane of the fire. This may be done by the use of a laser device or the like which might be attached to a truck, or which could operate separately or in a hand held manner. The purpose of the laser signal would be to broadcast a horizontal or otherwise preferred shaped signal above the fire, to be received by a the grenades and to initiate the timing of the release of the powder. In this way all of the grenades would burst at a designated height above the fire, and thereby more effectively douse the flames with fire retardant that may settle onto the source of the fire. The projectiles may burst and deploy the fire retardant by use of a small explosive charge. Alternatively a mechanical assembly may be used to deploy the fire retardant.

The grenades may be stacked in a mortar box to have a range of response times so that a calculated percentage of them burst at the time the signal is received, while others burst at a number of delayed times. The result of which may be that some grenades burst above the flames, some burst in the flames and in the case of tall grass and brush some burst in the fuel column. Others may remain as impact activated grenades. In this way, fuel structures such as branches and the like which might otherwise only be 'dusted' from the top, would also be dusted from below, and the material in vertical fuel column would be more effectively covered.

The grenades may receive signals of when to burst from a variety of other sources, such as radio frequency, and any other suitable means. Additionally the projectiles may be heat activated in that they include means for bursting, in part or in total, initiated by the heat of the fire.

Finned or otherwise controlled projectiles may be fitted with heat sensors, [infa-red for example] such that projectiles which might otherwise fall outside the fire perimeter, or more than a preferred distance outside the fire perimeter, would autonomously change course to fall inside the desired perimeter.

The method and apparatus of the present invention may also be employed in dousing fires that are burning in a more three dimensional volume. For example forest fires, in which case the vertical fuel column and the resulting flame column can be a considerable height may be attacked in accordance with the present invention. For instance it would not be uncommon for a forest fire to be operating in a vertical fuel column stretching from the floor of the forest to the top of the canopy. The height of this vertical fuel column makes the task of extinguishing the flames much greater than would be the case as described with grass and brush. A far greater number of grenades are required and an effective means of distributing the bursting of the grenades within the fire column is desired. It is preferred that a means of ensuring that the grenades burst at various depths in the column, to provide effective coverage of the column with fire retardant powder is provided.

Preferably the projectiles or grenades may be discharged into such fires from an aircraft. Additionally, in the forest fire / aircraft scenario, GPS may be used to establish the height of the aircraft, the height and contour of the forest floor, and this information can be electronically transferred to the mortars during firing. Radar may also be used to determine the height of the aircraft above the forest floor, and the

height of the top of the canopy. This information may be used to provide bursting instructions to the projectiles.

The trajectory of the grenades can be calculated by computer to accommodate wind, altitude, aircraft height and speed, forest floor contour and it may thus be available for an operator in the aircraft to have a VDU screen which can overlay the possible impact footprint of a firing onto an infra-red image of the fire. In this way, and/or where available with visual confirmation of the situation, the operator will be able to commence firing at a preferred moment, and will be able to engage the hottest seat of the flames. Further the present invention may be used to deploy fire retardant as a fire break.

Alternatively, the monitor may permit zones within the designated area to be avoided such that either the quantity of fire retardant deployed is minimised.

The use of autonomous control means and infra-red sensors on the grenades can reduce off-target waste, and more effectively concentrate the powder onto the fire.

In one embodiment, the barrel assemblies may be splayed relative to each other to concentrate or diffuse the fire from the mortar box dependent upon the nature of the fire.

In order that this invention may be more readily understood and put into practical effect, reference will now be made to the accompanying drawings which illustrate typical embodiments of the invention wherein:-

Figure 1 is an illustration of a fire for which the method of the present invention is applicable;

Figure 2 is an illustration of a fire fighting unit for use in the method of the present invention;

Figure 3 is an illustration of a fire fighting unit for use in the present invention.

Figure 4 is an illustration of a barrel assembly for use in accordance with the present invention.

Figure 1 shows a bush fire that is burning both on the ground and throughout the fuel column defined by the trees. In one embodiment of the present invention the fire retardants are configured to burst and deploy fire retardant at various heights above the ground and on the ground so as to quench the fire throughout its depth.

Figure 2 shows a fire fighting unit in the form of a truck. The fire fighting unit may also be airborne such as an aircraft or helicopter. The fire fighting unit includes a number of pods of barrel assemblies for firing projectiles carrying fire retardant. The fire fighting unit also has a laser guidance system for directing the projectiles containing fire retardant.

Figure 3 shows a manually deployable pod containing a plurality of barrel assemblies having projectiles that incorporate a fire retardant. Such a pod may be manually deployed in the field by a fire fighting team.

Figure 4 shows a typical cross section of projectiles loaded in a barrel where the projectiles 32 incorporate a propellant charge. The projectiles 32 sealably engage the barrel 35 through a tapered sleeve 34.

It will of course be realised that the above has been given by way of illustration only and that all such modifications as would be apparent to persons skilled in the art are deemed to fall within the broad scope and ambit of this invention as is herein set forth.

DATED THIS 6TH DAY OF JULY 2001

METAL STORM LIMITED

BY

PIZZEYS PATENT & TRADE MARK ATTORNEYS

FIGURE 1

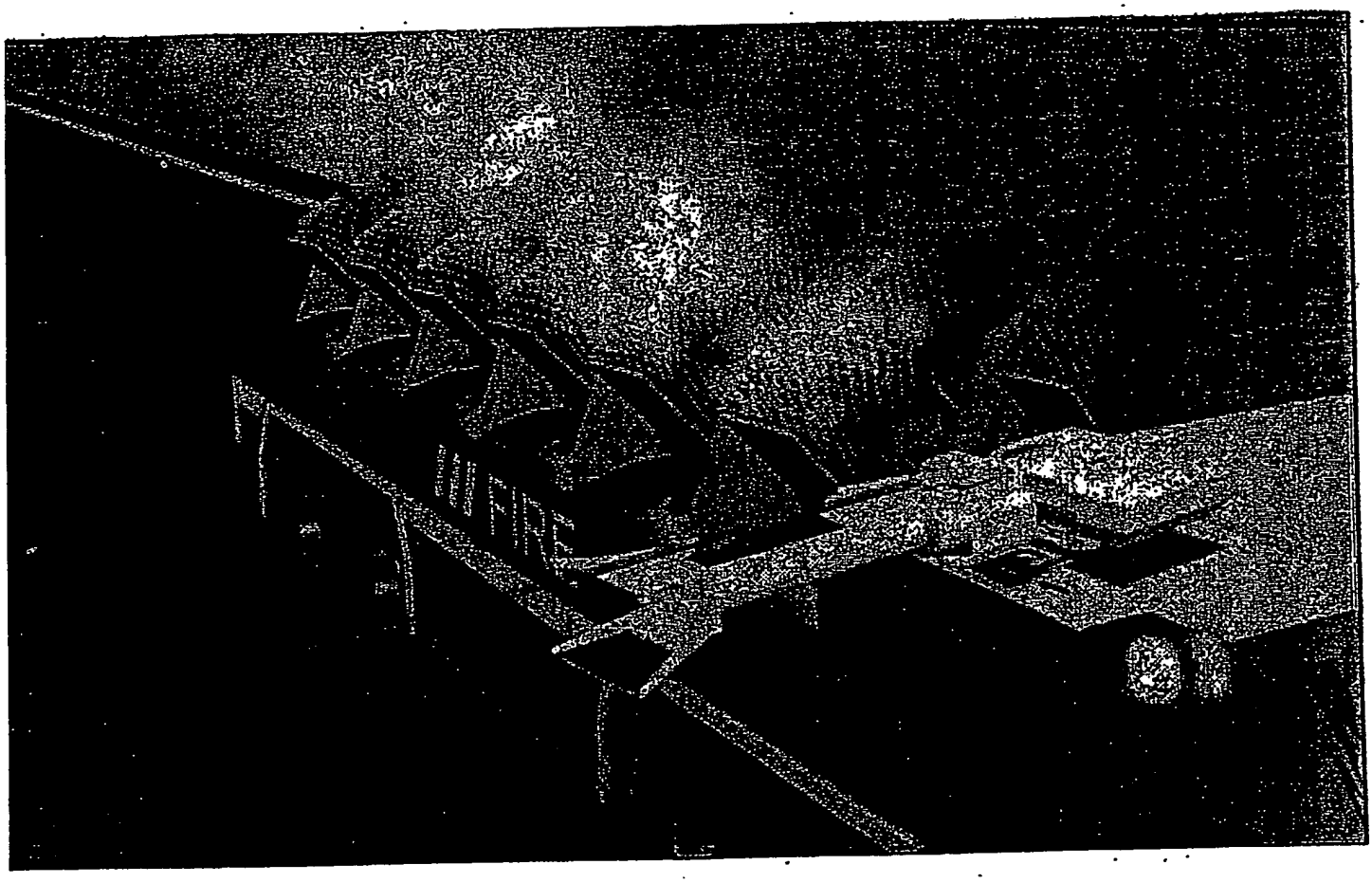

FIGURE 2

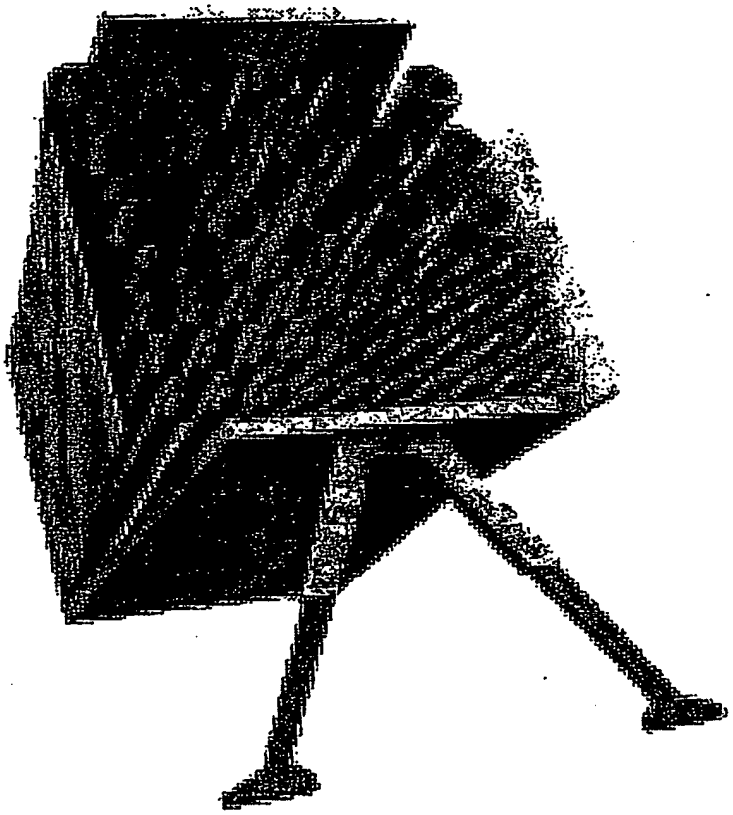

FIGURE 3

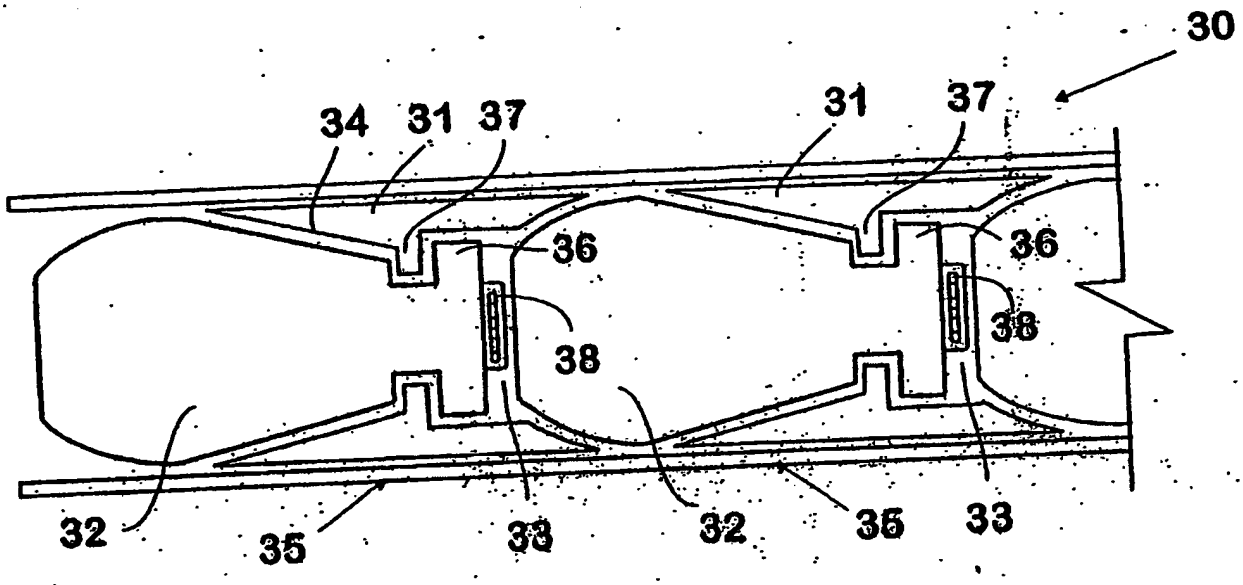

FIGURE 4